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ON THE FISHES OF NORTHERN INDIANA.

BY DAVID S. JORDAN, M.D.

The material on which the present paper is based was collected, in the summer of 1875, in the streams and clear, deep lakes of the northern part of Indiana, by Mr. Caleb Cooke, in the interest of the Peabody Museum of Science, and Dr. G. M. Levette, in the interest of the Indiana Geological Survey.

The collection consists chiefly of small fishes—darters, sunfish, and minnows—with the young of some larger species. About 60 species in all are represented.

The following are the localities :—

- I. Lakes without outlet to the sea.
 - a. Clear Lake, La Porte Co.
 - b. Pine Lake, La Porte Co.
- II. Waters tributary to Lake Michigan through St. Joseph's River and its branch, the Elkhart.
 - a. South Fork of the Elkhart, Rome City, Noble Co.
 - b. Tamarack Run, two miles south of Rome City.
 - c. Adams Lake, La Grange Co.
 - d. Stream at Syracuse, in Kosciusko Co.
- III. Waters tributary to Lake Erie through the Maumee River and its branch, "St. Joseph's of the Maumee."
 - a. Henderson Lake and Creek, Kendallville, Noble Co.
 - b. Sawyer Creek, outlet of Long Lake, Kendallville.
 - c. Outlet of Bixel's Lake, Kendallville.
- IV. Waters tributary to the Illinois River through Kankakee River.
 - a. Mill-pond and Creek, Union Mills, La Porte Co.
- V. Waters tributary to the Upper Wabash through Tippecanoe River.
 - a. Lake Manitou, Rochester, Fulton Co.
 - b. Centre Lake, Warsaw, Kosciusko Co.
 - c. Lake Tippecanoe, Kosciusko Co.
- VI. The Lower Wabash (Coll. F. W. Putnam, 1871).
 - a. Wabash River, Hutsonville, Crawford Co., Illinois.
 - b. Wabash River, Merom, Sullivan Co., Ind.
 - c. Turman's Creek, Sullivan Co.
 - d. A few specimens in my own collections from Terre Haute, Vigo Co.

For purposes of comparison I add:—

VII. White River and its tributaries—Fall Creek, Eagle Creek, Pleasant Run, and Pogue's Run—in the neighborhood of Indianapolis, in Marion Co. ; and Hurricane Creek, in Johnson Co. (Collections of Prof. H. E. Copeland and myself in 1874-77).

It will be noticed that, excepting Nos. VI. and VII., the above-mentioned localities are near together, all within a radius of 50 miles, but on five different sides of the water-shed of northern Indiana. A glance at the table below will show, however, that, in all these upland streams and lakes, the fish-fauna is essentially the same, although in some cases the waters flow to the Gulf of Mexico, in others to the Gulf of St. Lawrence. On the other hand, between the faunæ of the upper course of the Wabash River and that of the lower, and between both and the fauna of White River, there will be noticed certain striking differences.

These facts may be formulated as follows: More species of fishes are common to the head-waters of streams rising on different sides of a water-shed than are common to the upland and lowland courses of the same stream. This subject is ably discussed by Prof. Cope (Journ. Acad. Nat. Sci., Phil., 1868, 242-246).

In the following table are given, opposite the name of each fish, the number of specimens thereof in the collection from each of the different water-basins:—

	I. Lakes of La Porte Co.	II. St. Joseph's R.	III. Maumee R.	IV. Kankakee R.	V. Tippecanoe R.	VI. Lower Wabash R.	VII. White R.
PERCIDÆ.							
<i>Microperca punctulata</i> , Putn.	15	16	1	..	..	..	3
<i>Boleichthys eos</i> , Jor. & Copeland	20	1	1	..	10	..	3
<i>Nothonotus niger</i> (Raf.), Jor.	..	..	..	..	..	..	3
<i>Etheostoma flabellare</i> (Raf.), Jor.	..	..	..	..	..	..	3
<i>Pœcilichthys variatus</i> (Kirt.), Ag.	..	3	..	..	..	..	Common
<i>Pœcilichthys spectabilis</i> , Ag.	..	1	2	..	..	..	75
<i>Boleosoma brevipinne</i> , Cope	34	11	42	25	..	..	Common
<i>Diplesium blennioides</i> , Raf.	..	..	..	..	1	..	Common
<i>Imostoma shumardii</i> (Grd.), Jordan	..	..	..	..	6	..	50
<i>Alvordius aspro</i> , Cope & Jordan	..	..	..	..	..	..	..

	I. Lakes of La Porte Co.	II. St. Joseph's R.	III. Maumee R.	IV. Kankakee R.	V. Tippecanoe R.	VI. Lower Wabash R.	VII. White R.
PERCIDÆ.							
Alvordius phoxocephalus (Nelson), C. & J.	1					1	
Alvordius evides, J. & C.		3					3
Percina caprodes (Raf.), Grd.						1	Common
Percina manitou, Jordan		3					
Pleurolepis pellucidus (Baird), Ag.							150
Perca flavescens (Mit.), C. & V.	15	4			30		
Pomoxys annularis, Raf.						1	5
Pomoxys hexacanthus (C. & V.), Ag.					8		1
Micropterus floridanus (LeS.), Gill	13	8	7	6	19	12	Common
Micropterus salmoides (Lac.), Gill		1				2	Common
Chænobryttus gulosus (C. & V.), Cope	1				7		
Ambloplites rupestris (Raf.), Gill		1			1	4	Common
Apomotis cyaneus, Raf.		1		1			Common
Lepomis nephelus, Cope							25
Lepomis incisor (C. & V.), Cope	25	18	27		95	23	Common
Xenotis inscriptus (Ag.), Jor.							25
Lepomis peltastes, Cope				4			
Xenotis megalotis (Raf.), Jor.							20
Xenotis nitidus (Kirt.), Jor.							Common
Pomotis aureus (Walb.), Gill	2	1	1	6	5		
APHREDODERIDÆ.							
Aphredoderus cookianus, Jordan		1					
SCIÆNIDÆ.							
Haploidonotus grunniens (Raf.), Gill							Scarce
COTTIDÆ.							
Potamocottus wilsoni (Grd.), Gill							3
ATHERINIDÆ.							
Labidesthes sicculus, Cope	19		5		53	171	Common
CYPRINODONTIDÆ.							
Zygonectes notatus (Raf.), J. & C.		8	9			61	Common
Zygonectes dispar, Ag.			7		16		
Fundulus diaphanus (LeS.), Ag.	13	25					
UMBRIDÆ.							
Umbra limi (Kirt.), Gthr.	3	14	15		1		10
ESOCIDÆ.							
Esox lucius, L.		2					
Esox salmoneus, Raf.	11	1	2		1		Common

	I. Lakes of La Porte Co.	II. St. Joseph's R.	III. Maumee R.	IV. Kankakee R.	V. Tippecanoe R.	VI. Lower Wabash R.	VII. White R.
SALMONIDÆ.							
<i>Argyrosomus clupeiformis</i> sisco, Jor.					15		
CLUPEIDÆ.							
<i>Dorosoma cepedianum</i> (LeS.), Gill						1	
CYPRINIDÆ.							
<i>Campostoma anomalum</i> (Raf.), Ag.			5		1		Common
<i>Hyborhynchus notatus</i> (Raf.), Ag.	2	41	30	3	24		Common
<i>Hybognathus argyritis</i> , Grd.					7		3
<i>Ericymba buccata</i> , Cope							Common
<i>Semotilus corporalis</i> (Mit.), Put.		4	1	2	2		Common
<i>Nocomis biguttatus</i> (Kirt.), C. & J.	3	3		1	3		Common
<i>Nocomis amblops</i> (Raf.), C. & J.							Common
<i>Nocomis dissimilis</i> (Kirt.), C. & J.							25
<i>Rhinichthys obtusus</i> , Ag.				7			
<i>Rhinichthys atronasmus</i> (Mit.), Ag.							Common
<i>Hybopsis stramineus</i> , Cope				7			100
<i>Hybopsis plumbeolus</i> , Cope					3		
<i>Hybopsis storerianus</i> (Kirt.), Ag.	2						
<i>Hemitremia heterodon</i> , Cope (?)					5		
<i>Luxilus cornutus</i> (Mit.), Jor.	4	34		4	16		Common
<i>Episema scabriceps</i> , Cope							25
<i>Minnilus spilopterus</i> , Cope			3		10		75
<i>Minnilus analostanus</i> (Grd.), C. & J.						48	Common
<i>Minnilus ariommus</i> , Cope							50
<i>Minnilus dinemus</i> , Raf.							25
<i>Minnilus rubellus</i> (Ag.), Jor.						2	Common
<i>Minnilus rubrifrons</i> (Cope), Jor.					7		Common
<i>Notemigonus americanus</i> (Lac.), Jor.	12	16	5	24	10		Common
CATOSTOMIDÆ.							
<i>Catostomus teres</i> (Mit.), LeS.		6		9		1	Common
<i>Catostomus nigricans</i> , LeS.							Common
<i>Erimyzon oblongus</i> (Mit.), C. & J.	1	1	27	1	4		Common
<i>Erimyzon melanops</i> (Raf.), C. & J.						3	Common
<i>Moxostoma anisurum</i> , Raf.						6	
<i>Moxostoma duquesnii</i> (LeS.), Jor.						5	Common
<i>Placopharynx carinatus</i> , Cope						1	
<i>Carpiodes difformis</i> , Cope						1	
<i>Carpiodes carpio</i> , Raf.						1	5
<i>Ichthyobus bubalus</i> , Raf.						1	
SILURIDÆ.							
<i>Ictalurus punctatus</i> (Raf.), Jor.						1	5
<i>Amiurus cupreus</i> , Raf.	1	1			1	4	5

	I. Lakes of La Porte Co.	II. St. Joseph's R.	III. Maumee R.	IV. Kankakee R.	V. Tippecanoe R.	VI. Lower Wabash R.	VII. White R.
SILURIDÆ.							
<i>Amiurus nebulosus</i> (LeS.), Gill	..	..	..	..	1	..	Common
<i>Amiurus atrarius</i> (Dek.), Gill	1	5	19	..	..	..	..
<i>Hopladelus olivaris</i> (Raf.), Gill	..	..	..	..	..	1	..
<i>Noturus flavus</i> , Raf.	18	2	..	..	..	..	35
<i>Noturus miurus</i> , Jor. Mss.	..	1	..	..	8	..	60
AMIIDÆ.							
<i>Amia calva</i> , L.	..	..	1	..	..	..	..
LEPIDOSTEIDÆ.							
<i>Lepidosteus</i> "huronensis, Rich."	..	..	..	..	..	..	5
POLYODONTIDÆ.							
<i>Polyodon folium</i> , Lac.	..	..	..	..	..	..	5
PETROMYZONTIDÆ.							
<i>Petromyzon niger</i> , Raf.	..	..	..	..	..	..	25
<i>Petromyzon argenteus</i> , Kirt.	..	..	..	..	..	..	1

Notes and Descriptions.

I give here notes on some of the foregoing species, with descriptions of those less known, as well as of a few new species which have come to my notice from Indiana, Wisconsin, and Illinois.

1. *Boleichthys eos*, Jordan and Copeland, n. s.

Boleichthys exilis, Jordan Man. Vert., 1876 (in part—probably not of Girard Proc. Acad. Nat. Sci., Phila., 1859).

Boleichthys eos, Jordan Mss. Nelson Bull. Ills. Museum Nat. Hist. Soc., 1876, 34 (partial diagnosis, Wis. and N. Ills.)

? *Boleichthys exilis*, Nelson Bull. Ills. Mus. Nat. Hist., 34 (the small species or variety noted below).

Body elongated, slender, somewhat compressed, especially behind, rather heavy forwards, with long caudal peduncle. Head rather long, rounded in front, $3\frac{7}{8}$ in length, without caudal. Greatest depth of body $5\frac{1}{2}$ in length. Mouth small, little oblique, the upper jaw a very little longest. Eye large, $3\frac{1}{2}$ in head, rather high up, longer than snout.

Dorsal fins high, about equal, the second highest, rather shortest, the two well separated. Anal moderate, smaller than second dorsal, caudal truncate. Pectorals rather short, reaching about as far as tip of ventrals, not $\frac{2}{3}$ the distance to vent. Cheeks, opercles, neck, and ventral region with small scales. Thoracic region naked. Vent a trifle nearer snout than tip of caudal. Lateral line to end of first dorsal on 22 to 26 scales, the total number being 57 to 59.

Color (in alcohol) dark olive, with darker markings, *i.e.*, 10 or 12 blackish dorsal spots or bars, and as many short bars across the lateral line nearly opposite the dorsal bars but not continuous with them. Various sharply defined but irregular black markings on lower parts of sides and on cheeks, etc. Second dorsal, caudal, and pectorals strongly marked with wavy black bands as in *Catnotus*. In females the first dorsal is similarly specked. In males dark terminal and basal bars are present (blue in life). Top of head dark. A black streak forward from eye, and another downward.

The life colors are very brilliant. The interspaces between the lateral bars as well as most of the ventral region are of a brilliant vermilion. The first dorsal is bright blue, with a broad median band of crimson.

Fin rays D. ix—11 (rarely x—10 or x—11) A ii—7.

Length $2\frac{1}{2}$ to 3 inches. *Habitat*: Rock River, Wisconsin, Wisconsin River, Fox River, Illinois, and streams of North Indiana.

In Fox River (Wis.) Suamico River, and other tributaries of Lake Michigan, there occurs in abundance another *Boleichthys*; but whether specifically distinct from *B. eos* or not I am unable to say. My numerous specimens are all smaller, shorter, with large scales. Their coloration is different—plain brown with several large round red spots. This form is the *B. exilis* of Nelson's paper, and partly that of the Man. Vert., but it is very doubtful whether it is Girard's species which was described from the Upper Missouri.

The genus *Boleichthys* is very close to *Pæclichthys*. I know of no character on which to separate the eastern species as *Holelepis*. The short-arched lateral line and distinct, sub-equal dorsal fins as well as the general form seem to be common to all.

2. *Nothonotus niger* (Raf.), Jor.

This beautiful and rare species has been noticed by few authors, and has been properly described by still fewer. The following seems to be its synonymy:—

Etheostoma nigra, Raf. Ich. Oh. 1820, 37 (Kentucky; a superficial description).

Nothonotus niger, Jordan Bull. Buff. Nat. Hist. Soc., 1876, 93, 134 (name only). Man. Vert., 1876, 219 (male specimen).

Pæcilichthys niger, Jordan and Copeland Bull. Buff. Nat. Hist. Soc., 1876, 162 (name only). Nelson Bull. Ills. Nat. Hist. Mus. 34 (Wabash Valley).

Etheostoma maculata, Kirtland Bost. Journ. Nat. Hist., III., 276, 1841 (description incomplete and partly erroneous). Storer Synopsis, 271, 1846.

Nothonotus maculatus, Agassiz Bull. M. C. Z., 1863, 3 (name only).

Boleosoma maculatum, LeVaillant, Archives du Museum, 1873.

Catonotus maculatus, Jordan Ind. Geol. Surv., 1874, 214 (name only).

Pæcilichthys camurus, Cope, Proc. Am. Phil. Soc. 1870, 265 (Cumberland River, Tenn. Excellent description).

3. *Pæcilichthys variatus* (Kirt.), Ag.

Pæcilichthys cæruleus (Storer), Ag., and of most authors.

I have restored Dr. Kirtland's name for this species for the reasons given below. His description of *Etheostoma variata* has been variously misunderstood, as may be seen in its reference to genus *Hadropterus* by Putnam and *Boleosoma* by Le Vaillant. The latter author establishes a new genus, *Astichthys*, for *P. cæruleus* and its relatives, because, as assumed, the original type of *Pæcilichthys*, Ag. (*E. variata*) is a *Boleosoma*. Dr. Kirtland ascribes twelve dorsal spines to his *variata* and ten to his *maculata*. The reverse is the truth, and the two figures were perhaps accidentally interchanged, otherwise his descriptions in both cases are characteristic and fairly correct.

Recently specimens from Wisconsin, fully identified as *P. cæruleus* (Storer) by Profs. Putnam, Cope, Copeland, and the writer, were sent by Dr. Hoy to Dr. Kirtland, who unhesitatingly pronounced them to be his own *Etheostoma variata*. The following in regard to this point is from a private letter from Dr. Kirtland to Dr. Hoy in November, 1876.

"The *Etheostoma variata* I first indicated as an undescribed species of fish in the 2d Geological Report of Ohio, Nov. 1, 1838. In 1841 I published a description of it in Vol. III. of the Boston

Journal of Natural History, p. 274. In 1838 I indicated it as a native of the upper waters of the Ohio, and of the Lake Erie waters.

"Dr. Storer first described the *Etheostoma cærulea* in the Proceedings of the Boston Society of Natural History in 1845. At the time Dr. Storer's description appeared I had no doubt that his fish was the same as my *variata*, nor have I seen any reason since to change that conclusion. His specimen was probably received preserved in spirits; mine was described as it was fresh and alive—conditions affecting extensively their appearance. Sex, season of the year, spawning, locality, etc., vary greatly the character of fishes, and none more than this *Etheostoma*.

"My figure and description were made out from an old and large male taken from the spawning bed in the Mahoning River, in Youngstown, just as it had discharged its milt. It was lank, dull, and easily captured in its weak and emaciated condition, as all male fish are prone to be at this juncture. The brilliancy of its coloration had not yet become impaired. In a collection of many specimens you may find almost each one to differ from the others—some so essentially in their characters as to furnish new species to our 'new species mongers.'

"To that class of meddling naturalists I belonged at the time I described the *Etheostoma erythrogaster* and figured it in Hamilton Smith's 'Annals of Science.' It was a variety no doubt of the *variata*, a female teeming with eggs."

4. *Imostoma shumardii*. (Grd.) Jordan.

Hadropterus shumardi, Grd. Proc. Acad. Nat. Sci. Phila., 1859, 100, Arkansas. *Etheostoma shumardii*, Jord. & Copel. Bull. Buff. Soc. Nat. Sci. 1876.

Several specimens from the Wabash River at Hutsonville, are probably referable to this species. They appear to represent a new generic type, for which the name *Imostoma* is proposed (*eimi* to move, go—*stoma* mouth, in allusion to the projectile jaw, which distinguishes this genus from *Alvordius*). *Imostoma* may be thus characterized: Lateral line complete; body scaly; no ventral plates (?); upper-jaw projectile; vomerine teeth; anal as large as second dorsal. Type, specimens from Wabash River supposed to be *Hadropterus shumardii*, Grd.

Specific characters.—Body stout and heavy forward, compressed behind. Depth about 5 in length. Head blunt, broad,

and thick, resembling that of *Diplesium* (*Hyostoma*, Ag.), its length $3\frac{1}{2}$ in length of body to caudal, its depth at pupil half its length. Eye large, rather shorter than snout, $3\frac{1}{2}$ in head. Interorbital width $\frac{2}{3}$ of eye.

Mouth large and broad, the lower jaw wide, a little shorter than upper; maxillary reaching to eye. Cheeks, opercles, and neck scaly; chest naked. Abdominal region naked anteriorly, scaly in front of vent; no traces of mucronate plates in any of my specimens. Scales of body rather large; lateral line with 56 scales, about 6 above and 11 below.

Fin rays, D. x—15, A. ii. 11.

Dorsal fins large, first larger than second, which is smaller than anal, the two dorsal fins well separated. Anal fin large, prolonged behind, farther than the dorsal; in one specimen greatly elevated, reaching to the caudal. This is perhaps a sexual feature. Anal spines large, the first largest. Pectorals reaching to tips of ventrals $\frac{2}{3}$ to vent.

Color dark, densely but vaguely blotched with darker but not black. Sides with 10 or 12 obscure blotches, the anterior ones bars. A large black spot on base of spinous dorsal behind, and a small one in front. Second dorsal, caudal and pectoral barred as in *Alvordius aspro*. A very strong black suborbital bar, and a faint dark line across muzzle. Length 3 inches.

Habitat. Wabash River (Jordan), Arkansas River (Girard).

5. *Alvordius phoxocephalus* (Nelson), Cope and Jordan.

Etheostoma phoxocephalum, Nelson, Bull. Ills. Mus. Nat. Hist. I. 1876, 35 (Illinois River), Jordan and Copeland, Bull. Buff. Soc. Nat. Sci. 1876.

An additional specimen of this species, in better preservation than any of Nelson's types, enables me to give a fuller description, and to correct one or two slight errors in the original account.

Body rather slender, compressed, depth $5\frac{1}{2}$ in length. Head 4 in length, extremely long, narrow, and tapering; the snout very acuminate. Mouth large, somewhat oblique, the maxillary reaching to eye, the lower jaw unusually narrow and long, scarcely shorter than upper. Depth of head at pupil one-third its length. Eye $4\frac{1}{4}$ in head, about equal to snout; half wider than interorbital space. Teeth small, on jaws and vomer. Upper-jaw not projectile.

Cheeks, opercles, and neck with small scales; those on the

cheeks imbedded but numerous; chest naked. Ventral line with enlarged plates. Scales small, 68 in lateral line, about 12 above and 14 below. Fin rays, dorsal xii—13 (xiii—12, Nelson) A. ii. 9. Dorsal fins well apart, the second about equal to anal; the spinous dorsal long; caudal lunate. Pectorals reaching to tips of ventrals, $\frac{2}{3}$ to vent.

Color brownish above, mottled with darker. Lateral line with about 12 blackish spots, which are more or less quadrate, and scarcely twice the size of the eye. Both dorsals, and caudal with narrow dark bars of spots. A black streak on muzzle, but the suborbital bar very obscure. A small black spot at each end of the lateral line.

The peculiar form of the head and mouth separate this at once from all the previously known species except *A. macrocephalus*, Cope. The latter has naked cheeks and opercles, and differs in several other respects.

Habitat. Illinois River (Nelson), Wabash River (Jordan).

6. *Alvordius aspro*, Cope and Jordan, nom. sp. nov.

Etheostoma blennioides, Kirtland, Bost. Journ. Nat. Hist. (figure, but not description, which is copied from Rafinesque).

E. blennioides, Agassiz, and later writers.

Etheostoma blennioides, Raf., is the fish usually known as *Hyostoma cymatogrammum*, and for that fish his name must be retained. *E. blennioides*, Auct., being thus left without a specific name, that of *aspro* is here proposed.

The genus *Etheostoma*, Raf., was originally based on *E. flabelaris*, *E. caprodes*, and *E. blennioides*. The last two afterwards formed the subgenus *Diplesion*, leaving *Etheostoma* for *E. flabellare*.

7. *Alvordius evides*, Jordan & Copeland, sp. nov.

Etheostoma nigrofasciatum, Manual Vert. 1876, p. 223 (not *Hadrop-terus nigrofasciatus*, Ag.).

Etheostoma evides, Jordan & Copeland, Mss. in Nelson, Bulletin Ills. Hist. Soc. Dec. 1876, p. 36.

Body elongate, rather short for the genus, little compressed, depth $5\frac{1}{2}$ in length, without caudal. Head heavy, $4\frac{1}{4}$ in length to caudal; its greatest depth equal to its breadth, $1\frac{3}{4}$ in its length. Profile convex, outlines prominent just behind eyes, depressed at occiput. Eye large, rather high, their length rather more than snout, and than interorbital space $3\frac{1}{2}$ in head. Upper jaw a little

the longer. Mouth not so large as in *A. aspro*, a little oblique, the maxillary reaching to opposite front of orbit. Vomerine teeth. Upper jaw not protractile, the skin of the middle of the lip continuous with that of the forehead. Cheeks, neck above, and throat naked; opercles with a few rather large scales. Ventral strip naked in one specimen, with a few enlarged scales in the other. Vent midway between eye and tip of caudal.

Fin rays; dorsal x—10 (xi—10), anal ii. 8 (ii. 9).

Pectoral fins as long as head, their tips about even with those of the ventrals. Ventrals long, their tips reaching $\frac{2}{3}$ the distance to vent. Anal rather short and unusually high, the longest rays extending farther back than the longest dorsal rays when the fin is depressed, the height of the longest ray $\frac{2}{3}$ the length of the head. Anal spines well developed, their height $2\frac{1}{2}$ in head.

Spinous dorsal long, moderately high, lower than the soft dorsal, its base equal to the distance from its first ray to the front of the eye. Dorsal fins well apart, separated by a distance greater than the diameter of the eye. Second dorsal lower than anal, but with a longer base, the two fins about equal in absolute size. Caudal fin moderate, emarginate, as long as from tip of muzzle to anterior margin of opercle.

Color dark-grayish or olivaceous above, tessellated with black. Top of head dark. A black band across top of head, just behind the interorbital space; a distinct vertical suborbital bar; a broad horizontal stripe across upper part of cheeks on the level of the pupil, becoming a narrow stripe across the opercle.

Body with about seven broad transverse black bars, extending from below lateral line on one side across the back and down the other side. These are rather faint above, their color blending with the dark of the back, and they are broadest and most distinct along the lateral line, just below which they end rather abruptly. These bars are wider than the eye, and most of them extend a distance below the lateral line equal to the diameter of the eye. These bars are connected along the lateral line by a faint black stripe. The fourth band is rather the most distinct, and it passes over the back in the interspace between the two dorsal fins. The two posterior bars are rounded and spot-like, but they also meet across the back. Dorsal with one or two longitudinal blackish streaks, and some vague markings on caudal. Fins otherwise uncolored.

Belly and lower parts clear, creamy, becoming pale orange behind ventrals. Interspaces between bands whitish with dark spots. In the smaller specimen which has been longer in alcohol, the black has faded to a dark chestnut.

Habitat. White River near Indianapolis in rapid water on stony bottom. The three specimens known were taken by Prof. Cope-land and the writer at the same point at different times. The largest specimen measures $2\frac{1}{2}$ inches, the others $2\frac{1}{4}$.

This species is one of the most beautiful of all the darters. Its colors, though not gaudy, are very striking, and quite unlike those of any other species known to me, resembling most those of *Alvordius aspro*.

In the Manual of the Vertebrates of the N. E. U. S., I identified the only specimen then in my possession with *Hadropterus nigro-fasciatus*, Ag., but that species turns out to be something quite different. The small number of dorsal spines as well as the peculiar coloration separates *A. evides* at once from its congeners *aspro*, *maculatus*, *macrocephalus*, *phoxocephalus*, and *nevisensis*. *A. fasciatus* is the only species which resembles it in this respect, but it is otherwise entirely different.

***Percina manitou*, Jordan, sp. nov.**

Body elongate, cylindrical, less compressed than in *P. caprodes*, the depth being about 7 in length. Head $4\frac{1}{4}$ in length (without caudal), slender, but noticeably shorter and broader than in *P. caprodes*, the snout being considerably shorter, blunter, and less sloping. Eye large, about equal to snout, $3\frac{1}{2}$ to 4 in head, greater than interorbital space. Mouth small, less inferior, and less deeply cleft than in *P. caprodes*, the maxillary not extending to opposite eye, the upper lip—as in *P. caprodes*—not protractile. Cheeks and opercles with small scales, the former hardly visible.

Scales small, about 90 in the lateral line, which is well-developed and continuous. Ventral line with enlarged, mucronate plates (in one specimen—in the others naked); chest naked; region anterior to dorsal fin above *entirely scaleless* and smooth—in *P. caprodes* this region is densely scaled, like the sides.

Fin rays, D. XV., 14. A. II., 10.

Fins moderate, ventrals reaching about half way to vent, rather further than pectorals.

Colors black and yellowish olive, as in *P. caprodes*, but the pattern different. The back irregularly and strongly marbled as

in *Alvordius aspro*, the lateral bars being short, and not extending up the sides much above the lateral line, the bars on one side not meeting their fellows on the opposite side. The bars themselves are subequal, not so sharply defined as in *P. caprodes*, short, about 20 in number, the last few blotch like, the last one a round jet black spot.

In *P. caprodes* the bars are alternately long and short, and each one meets its fellow of the other side across the back, a particularly distinct one crossing the back between the dorsal fins.

Dorsal fins and caudal mottled in both species.

Habitat. Lake Manitou in N. Ind., one of the sources of Tippecanoe R., 3 specimens in the Ind. State collection, each $3\frac{1}{4}$ to $3\frac{1}{2}$ inches long.

This species is, of course, closely allied to *P. caprodes*, but the different coloration and physiognomy, as well as the smooth neck, well distinguish it.

P. carbonaria, B. and G., from Texas, is apparently not identical with *P. caprodes*. I have numerous specimens of the latter from Alabama R.

Comparison of the Etheostomoid Genera.

The genera, which seem to be worthy of retention, in the peculiar group, family, or subfamily of *Etheostomidæ* (or *inæ*), may be thus compared :—

- * No lateral line ; dorsal fins small, not very unequal, the two well separated, both larger than anal ; jaws about even ; scales large ; no ventral plates ; upper jaw not protractile ; size small ; colors dull ; fins barred. MICROPERCA, 1.
- ** Lateral line present on anterior half of body or less ; upper jaw not protractile ; caudal rounded ; no ventral plates ; second dorsal larger than anal ; fins barred.
- † Dorsal fins well separated, about equal ; jaws nearly equal ; lateral line curved high over pectorals ; cheeks and opercles scaly ; body elongated and compressed ; colors often bright. BOLEICHTHYS, 2.
- †† Dorsal fins distinct, about equal, the first short, but nearly as high as second ; cheeks and opercles scaly ; lower jaw longest ; body elongated ; a dark lateral band. ALVARIUS, 3.
- ††† Dorsal fins unequal, the first scarcely half the height of the second and rather short ; cheeks and opercles naked ; lower jaw longest ; body elongated, compressed ; branchiostegal membranes broadly united ; coloration in bars or lines of dots. ETHEOSTOMA, 4.

*** Lateral developed for at least two-thirds the length of the body.

a. Body moderately elongated; scaly, excepting sometimes definitely naked areas on neck, chest, and ventral line.

b. Second dorsal considerably larger than anal; no ventral plates; the middle region of the belly scaled.

c. Upper jaw not protractile; dorsal fins contiguous, the membrane of the first just reaching the base of second; mouth medium, the upper jaw a trifle the longer; cheeks naked (scaly in *N. zonalis*); body short, and usually deep; fins large, not barred, but in the female speckled; colors brilliant.

Lateral line incomplete.

POECILICHTHYS, 5.

Lateral line complete.

NOTHONOTUS, 6.

cc. Upper jaw protractile; mouth small, horizontal, and more or less inferior; lateral line complete; fins barred.

d. Vomerine teeth; anal spines often obscure or obsolete; dorsals contiguous, but separate; spinous dorsal rather short; body elongated; colors plain.

BOLEOSOMA, 7.

dd. No vomerine teeth (at least in typical species); anal spines strong; cheeks and opercles scaly; body elongated, little compressed; head short and thick, with swollen cheeks; mouth very small; color bright.

DIPLESIMUM, 8.

bb. Second dorsal not larger than spinous dorsal, and little, if any, larger than anal, the two dorsal fins well separated; body little compressed; vomerine teeth; lateral line complete; two anal spines (except in *Alvordius peltatus*—a species of uncertain affinities); color, yellowish, with black bars and blotches.

e. Mouth wide, terminal, the upper jaw but little longest.

f. Upper jaw protractile; cheeks and opercles scaly; no ventral plates (?), body stout; head short and heavy.

IMOSTOMA, 9.

ff. Upper jaw not protractile.

g. No ventral plates; the middle line of the belly with small scales; cheeks and opercles scaled.

HADROPTERUS, 10.

gg. Ventral plates present (or falling, leaving a naked strip).

ALVORDIUS, 11.

ee. Mouth narrow, inferior, overlapped by a tapering, more or less truncate, pig-like snout; cheeks and opercles scaly; ventral plates present; or, if fallen, a naked strip; body elongated; size largest.

PERCINA, 12.

aa. Body excessively long and slender, cylindric, with very thin, transparent scales, which are wanting over the ventral region, and scarcely visible on the dorsal; lateral line complete; cheeks and opercles scaly; mouth large; the upper jaw sub-protractile, and a little the longer; vomerine teeth; dorsal fins small, wide apart; head elongated; color transparent, with dorsal and lateral series of small dark spots.

PLEUROLEPIS, 13.

Of the genera admitted above, *Alvarius* is imperfectly known. *Nothonotus* may be only a subgenus of *Pæcilichthys*, and *Alvordius* of *Hadropterus*. The claim of some of the others to independent rank seems not to be beyond question.

The other generic names used in this group seem to be synonyms, as follows:—

Hololepis, of *Boleichthys*.

Pegedictis, *Catonotus*, of *Etheostoma*.

Oligocephalus, *Astatichthys*, of *Pæcilichthys*.

Arlina, *Estrella*, *Cottogaster*, of *Boleosoma*.

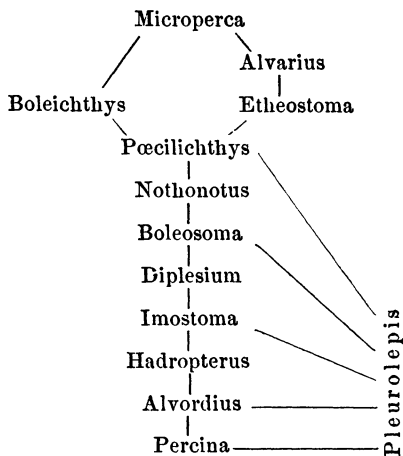
Hypohomus, *Plesioperca*, of *Hadropterus*.

Pileoma, *Asproperca*, of *Percina*.

Aplesion, Grd., I do not know. *Pegedictis*, Raf., is, perhaps, based in part on *Catonotus*, and in part, perhaps, on the young of some Cottoid.

It is undoubtedly best to discard the name *Pegedictis*, which I unadvisedly revived in place of *Potamocottus*, Gill.

The relations of these genera may be rudely shown by the following diagram:—



7. *Copelandia eriarcha*, Jordan, sp. nov.

In a collection of Wisconsin fishes sent by Dr. Hoy to Prof. Copeland and myself for identification, I find a species of saw-fish which appears to be the type of a distinct genus. For this genus I have proposed the name of *Copelandia*, dedicating it to the memory of one of the most enthusiastic of naturalists, and most

genial of men, whose untimely death has been a great loss to our science.

The genus *Copelandia* is allied to *Enneacanthus*, *Hemioplites*, and *Centrarchus*. Its characters are as follows:—

Dorsal with 10 spines, anal with 4; the anal spines strong, the soft rays high; caudal fin rounded; opercle emarginate, with a black dermal border (as in *Enneacanthus*). A supernumerary maxillary bone. Palatine teeth. Appendages of anterior gill arch long, and in small number, much as in *Ambloplites*.

The typical species *C. eriarcha* is thus characterized: Body rather elongated, more so than in *Enneacanthus*, the profile forming a nearly uniform curve. Depth $2\frac{1}{4}$ in length; head $2\frac{3}{4}$; caudal peduncle rather abruptly narrowed. Form most like that of *Apomotis cyanellus*, Raf. (*mineopas*, Cope). Eye very large, 3 in head; longer than snout; much more than interorbital space; mucous channels not large: scales on cheek large, in about three rows; mouth moderately large; the maxillary short and broad, with a distinct supplemental bone. Distance from snout to dorsal equal to length of the base of that fin; spines rather high, the longest equal to distance from snout, just past pupil; the first spine short, the last regularly longer. Soft dorsal high, its height equal to distance from snout to front of opercle. Caudal fin slightly rounded, its length $\frac{2}{3}$ that of head. Anal fin very large, beginning well forward, midway between base of caudal and nostrils. Spines 4, all strong, the last very large and strong, as long as from snout to posterior part of pupil. Soft rays a little higher than those of dorsal, and reaching base of caudal. Ventral fins large, with a strong spine which reaches to beginning of anal, the longest soft ray reaching first soft ray of anal. Pectorals moderate, about as long as the base of anal, reaching to tips of ventrals. Scales large, 3—33—10; lateral lines running high, parallel with the back, ending about opposite last rays of dorsal.

Fin rays D. X., 9; A. IV., 8; V. I., 5.

Color faded in spirits. Vertical fins with numerous round whitish spots, which were probably blue in life; a black, opercular spot. Length, 3 inches.

Habitat.—Menomonee R., at Wauwatosa, Milwaukee Co., Wis. Coll., Dr. P. R. Hoy.

8. *Lepomis peltastes*, Cope.

The sunfish referred to by Nelson (*op. cit.* 38) as *Ichthelis anagallinus*, from Fox R., Ills., is not Cope's *anagallinus*, but another species, probably *Lepomis peltastes*, Cope, a species which, following Prof. Bliss (*in lit.*), I have hitherto considered identical with *anagallinus*. Both *oculatus*, Cope, and *peltastes*, Cope, I now consider distinct species. I have specimens of *anagallinus* from Salt R., Ky., of *oculatus* from Racine, Wis., and of *peltastes* from the Upper Illinois.

Prof. Cope and the writer have reviewed the nomenclature of our Centrarchine genera, and have jointly come to the conclusion that the genera mentioned in the synopsis below are the ones worthy of adoption.

We have deemed that science would be best served by applying to these names the strict rules of zoological nomenclature. The grounds on which proposed changes are based are given in a supplement to this paper. The characters of the genera adopted are brought out in the following synopsis. Most of them were first pointed out by Prof. Cope, but for their arrangement here the present writer only is responsible.

Comparison of the Centrarchine Genera.

The genera of sunfishes (*Centrarchidæ*) may be thus compared:—

- * Dorsal fin much more developed than anal fin (the base of the former $1\frac{1}{2}$ to 3 times that of the latter), the soft parts of the two fins about equal, and terminating at the same vertical behind; long gill rakers if present, in small number, about 10.
- † Anal spines 3 or 4.
 - a. Caudal fin emarginate; anal spines 3; dorsal spines (normally) 10.
 - b. Opercle ending behind in an entire convex process or flap, which always has a black spot; dorsal fin not notched.
 - c. Maxillary without supplemental bone; mouth rather small, with equal jaws; maxillary usually not reaching to orbit; scales ctenoid.
 - d. Lower pharyngeal bones broad, with blunt, rounded, "paved" teeth. Appendages on anterior branchial arch ("gill rakers"), short, blunt, and weak; no palatine teeth.
- POMOTIS, 1.
- dd. Lower pharyngeal bones narrower, with fewer teeth which are conic and sharp.

- e.* Gill appendages short, blunt, and weak, not differentiated—as in *Pomotis* (species with the opercular flap much elongated—the spines low, the colors brilliant, cheeks ordinarily with blue stripes, and no palatine teeth).
XENOTIS, 2.
- ee.* Gill rakers long and slender, the lowermost 8 or 10 larger than the rest (species with the dorsal spines more or less elevated, the opercular flap comparatively broad and short, the colors less brilliant—though often lustrous, and often no blue lines on cheeks—palatine teeth often present).
LEPOMIS, 3.
- cc.* Maxillary with a supplemental bone; gill appendages long (as in all the following genera); lower pharyngeal teeth conic (as in all the following); mouth rather large, the lower jaw protruding; scales weakly or not ctenoid; palatine teeth (as in all the following).
- f.* Tongue without teeth; supplemental bone narrow; maxillary reaching to between front and middle of orbit; general aspect of *Lepomis*.
APOMOTIS, 4.
- ff.* Tongue with a conspicuous patch of teeth; supplemental bone large; mouth wide, reaching to opposite posterior margin of eye; form, aspect, and dentition of *Ambloplites*, etc.
CHÆNOBRYTTUS, 5.
- bb.* Opercle emarginate behind—ending in two flat points with a dermal border (as in all the genera following); dorsal fin deeply notched, separated almost into two fins, the last spines being shortened; body elongate; mouth very wide—the lower jaw longest, the supplemental maxillary large; gill appendages long; size large.
MICROPTERUS, 6.
- aa.* Caudal fin rounded; mouth small, with equal jaws; gill appendages long, in small number; opercle emarginate; species of small size.
- g.* Dorsal fin angulated, the middle spines longer than some of the posterior ones; supplemental maxillary wanting (or rudimentary?); anal spines 3; dorsal 10; body barred.
MESOGONISTIVS, 7.
- gg.* Dorsal fin continuous; supernumerary bone well developed.
- h.* Dorsal spines normally 9; anal spines 3.
ENNEACANTHUS, 8.
- hh.* Dorsal spines 10; anal 4.
COPELANDIA, 9.
- hhh.* Dorsal spines 8; anal 4.
HEMIOPLITES, 10.
- †† Anal spines 5 to 7; dorsal spines 10 to 13; teeth on tongue and palate; mouth large; a strong supplementary maxillary bone; lower jaw longest; opercle emarginate; gill appendages long and strong—8 or 10 of the large ones.

- i. Caudal fin rounded; scales cycloid; anal spines normally five. ACANTHARCHUS, 11.
- ii. Caudal fin emarginate; scales ctenoid; anal spines normally six. AMBLOPLITES, 12.
- ** Dorsal and anal fins about equal in extent, the soft portion of the latter longest and most posterior, the two fins being obliquely opposed; lower jaw longest; supplemental maxillary bone present; opercle emarginate; gill rakers very long, in large number (20 to 30); fins large; scales faintly or not ctenoid.
 - k. Spinous dorsal shorter than soft part, continuous with it—the species 5 to 8 in number, rapidly graduated; anal spines normally 6; body compressed and rather elongate; mouth large. POMOXYS, 13.
 - kk. Spinous dorsal longer than soft part, forming an angle with it, the spines about 12 in number, not rapidly graduated; anal spines normally 8; body deep; mouth moderate. CENTRARCHUS, 14.

9. *Aphrodedirus cookianus*, Jordan, sp. nov.

In the collection from St. Joseph's River of the Maumee, I find a single specimen of a Pirate Perch, which differs about equally from the Eastern *A. sayanus*, and the *Sternotremia isolepis*, recently described by Mr. Nelson from Illinois. Its characters are so peculiar that I see no alternative but to consider it as a new species, and to refer it to the genus *Aphrodedirus*.

Body broad, stout, elevated at the dorsal, the depth $3\frac{1}{2}$ in length, without caudal. Head large, broad and stout, 3 in length, its greatest thickness a little more than half its length, its depth at the pupil a little less. Mouth wide, lower jaw longest; maxillary reaching anterior margin of eye. Eye moderate, $4\frac{1}{2}$ in snout, its posterior margin nearly midway of head, $1\frac{1}{2}$ in snout, and in interorbital space. Lower posterior angle of cheek about a right angle.

Fin rays D. III., 11. A. II., 6. V. 7. B. 6.

Beginning of dorsal much nearer snout than base of caudal, base of dorsal $1\frac{1}{2}$ in distance from snout to first ray; pectoral as long as from snout to opercular margin; tips of pectorals not reaching as far as those of ventrals.

Ventrals considerably more than half length of head, reaching $\frac{4}{5}$ the distance to anal. Long anal spine $2\frac{1}{2}$ in head; caudal rounded.

Vent midway between junction of branchial membranes and

ventral fins, about $\frac{2}{3}$ the diameter of the eye behind the little knob which is on the throat in all the species of this family, the length of the snout in advance of the ventrals, about under the middle of the opercles.

Scales very small, strongly ctenoid, not easily seen along middle of body, largest on cheeks and on opercles. Lateral line distinct for a short distance only, about 58 scales in its entire course.

Color dark olive, appearing bronze in spirits, profusely speckled with dark points, which give the fins a dark color; a dark bar at base of caudal and a light one behind it. Length 3 inches.

Habitat. Sawyer's Creek, outlet of Long Lake, Kendallville, N. E. Indiana (Waters of Lake Erie). This species is named in honor of the naturalist who first collected it.

This fish differs from *Sternotremia isolepis* in the anterior position of the vent, which is nearly as in *Aphrodedirus sayanus*. It is stouter, has a larger head, smaller scales, and a shorter anal spine. The ventral fins are also decidedly larger and longer. Several minor differences are noticeable on comparison with one of Nelson's types. *Aphrodedirus sayanus* has a more elongated body, a longer head, much larger scales, a more backward position of the dorsal, and an increased number of spines in the dorsal and anal. At least such is the case in a specimen examined by me from near Philadelphia. The position of the vent in *Sternotremia* seems sufficient to characterize that genus, but the species of the two genera, as among our *Centrarchidæ* and *Cottidæ*, are "cast in the same mould." *Sternotremia* apparently represents a step in a transition from *Aphrodedirus* towards *Percidæ*.

In the original description of *S. isolepis* (Bull. Ills. Mus. Nat. Hist., I., 1876, 39), "Vent more than twice as far from lower jaw as from ventrals," should read from *tips* of ventrals."

10. *Cottopsis riccii*, Nelson.

Nelson, Bull. Ills. Nat. Hist. Soc., 1876.

A second specimen of this curious species, received from Dr. P. R. Hoy, of Racine, Wis., enables me to supplement the original description. The occurrence in the Great Lakes of this type formerly supposed to be peculiar to the Pacific Slope is very interesting.

Body moderately elongated, depressed; the head especially so. Depth $5\frac{1}{3}$ in length, the head $3\frac{2}{5}$. Body quite abruptly contracted

opposite the base of anal, the body behind head nearly as deep as wide.

Body behind the vent rather slender, subterete, giving a tadpole-like form to the body.

Jaws about equal, the lower narrower, but projecting in front; mouth rather contracted, the maxillary scarcely reaching to eye. Palatine teeth. Eye $4\frac{1}{2}$ in head, half wider than the interorbital space, about equal to snout. Eyes close together, entirely superior.

Head very broad and flat, as broad or broader than long, including the perpendicular spines, its depth half its length. Profile rising rapidly from head to base of dorsal, which runs along a decided ridge or carina.

Preopercular spine extremely large, more than three times as large as in any other of our fresh-water Cottoids, and as long as the eye. This spine is hooked backwards, and is slightly spiral, giving the fish a decidedly buffalo-like or cow-like physiognomy. Three spines hooked downwards, below the large one, the lower concealed. A strong spine directed forwards at base of opercle. Isthmus as wide as from snout to middle of orbit.

Fin rays, D. VIII—17. Anal 12. Ventrals I. 4. Pectorals 16. Branchiostegals 6.

Base of pectorals crescentic, their tips just short of anal, the rays all simple. Ventrals under pectorals reaching $\frac{2}{3}$ to vent; their membrane decurrent. Dorsal beginning a trifle beyond ventrals, rather nearer anal than snout. Vent midway between base of caudal and snout. Depth at first ray of anal less than half length of head, the thickness at the same point a little more than one-third. Least depth $\frac{1}{4}$ of head. Caudal peduncle slenderer than in any other Cottoid known to me in our fresh waters. Head smooth. Space above lateral line, behind head covered with small stiff prickles, slightly hooked backwards, readily visible as little black specks when the skin is dry. Axillary region *not* provided with spines. (These are present in most species of *Potamocottus*.)

Color pale brown, rather finely specked and mottled with darker brown, not at all as in *Uranidea*, much as in *Lota*, more as in *Lophopsetta*. Pectorals mottled; belly white. Length of smaller specimen (Nelson's type) $2\frac{5}{8}$ inches; of larger, $3\frac{3}{4}$.

Habitat. Lake Michigan, in deep water. Two or three other

specimens have been seen, but never preserved (Dr. Hoy). The cow-like expression of the face is very characteristic.

11. *Uranidea hoyi*, Putnam, MS.

Uranidea hoyi, Putnam MS. (1875). Jordan, Man. Vert., 1876, 244 (name only). Jordan and Copeland, Bull. Buff. Soc. Nat. Sc., 1876 (name only). Nelson, Bull. Ills. Mus. Nat. Hist., 1876, 41 (diagnosis).

This species has been for some time named in MS., but no full description published. Putnam's types are now in my possession. They show the following characters. The portion relating to the vertical fins is taken from notes by Dr. Hoy, as those parts are now entirely obliterated on the specimens.

Body small, rather short and thick, the depth about $5\frac{1}{2}$ in length. Head $3\frac{1}{2}$ in length, to base of caudal. Eyes large, high up, and close together; about equal to snout, $3\frac{2}{3}$ in head, three times the interorbital space. Head rather narrow and contracted; the lower jaw narrowed and slightly projecting. No palatine teeth (?); maxillary reaching anterior border of eye, or a little beyond.

Preopercular spine prominent, sharp, very nearly straight, directed backwards, but not strongly upwards; its form and direction peculiar in this genus. Below this is another sharp, prominent spine, also nearly straight, directed partly downwards. One or two minute concealed spines still lower. Isthmus well developed.

Pectoral fins long, longer than the head, reaching beginning of anal. Ventral fins long, reaching almost to vent. Vent midway between snout and base of caudal (in ♂); in the female further back, owing to the distended abdomen. Ventral rays I. 3 (on one side of each specimen apparently I. 4; perhaps a soft ray has been split).

Fin rays "D. VI. 15; A. 11; V. I. 3; P. 13; C. 12; the first dorsal low and small, $\frac{3}{4}$ as long as soft part, and connected to it by membrane. Fins all low." (Dr. Hoy.)

Color nearly obliterated. Lower parts profusely punctate.

Length of specimens, $2\frac{1}{8}$ inches.

Habitat. Lake Michigan—in deep water.

Female specimen taken 12 miles off Racine, Wis., in 12 fathoms, June 4th, 1875, by Dr. Hoy; the male off Milwaukee, June 15th. The specimens are now in bad condition, from rough handling.

The female is distended with ripe eggs, so that the width of the body is one-third the total length.

This species seems to be quite distinct from all those described by Girard. The peculiar characters are the number and form of the preopercular spines, the contracted mouth, the large eyes, the small size of the body, and the length of the ventral fins. The characters first mentioned are the most striking, and they indicate some affinity with *Trigloporus*.

12. *Uranidea kumlienii*, Hoy, MS.

U. kumlienii, Hoy, Nelson, Bull. Ills. Mus. Nat. Hist., 1876, 41.

One of Dr. Hoy's types, in very bad condition, is in my possession. It has grown soft in weak alcohol, and its remarkable slenderness of body is, perhaps, in part at least, due to this fact.

Body slender and elongated, as in *U. boleoides*; its depth 6 (?) times in length. Head large and long, its width a little more than half its length, its depth a little less, $3\frac{1}{2}$ in length of body. Eye large, $3\frac{1}{2}$ in head, about equal to snout, more than twice the width of interorbital space.

Base of pectorals crescentic; the fin about as long as head; the lower rays rapidly shortened, reaching second or third dorsal ray, and falling just short of anal; fourth and fifth rays longest. . . . Vent equidistant between base of caudal and front of eye.

Mouth pretty wide and oblique, the maxillary reaching to middle of eye. Lower jaw projecting. No palatine teeth. Preopercular spine large, directed upwards and backwards, not strongly hooked.

Fin rays, D. VI. 17; A. 12; P. 14; V. I. 3.

First dorsal rather high; $\frac{2}{3}$ the height of the second; the second spine longest, and filamentous (as is apt to be the case in rotten Cottoids); the two fins connected by a membrane. Caudal peduncle slender. Caudal fin narrow, more than $\frac{3}{4}$ length of head. Second dorsal and anal high.

Lateral line disappearing under middle of second dorsal.

Color obliterated—traces of a black spot on spinous dorsal.

Length of specimen, 3 inches.

Lake Michigan, in deep water. (Dr. Hoy.)

This species is dedicated by Dr. Hoy to Mr. A. L. Kumlien.

Nelson's description (l. c.) was made up from my notes on this specimen.

Genus **EUCALIA**, Jordan, 1876.(Man. Vert., 1876, 248; type, *Gasterosteus inconstans*, Kirt.)

Some three years since I separated this genus in MS., and I adopted it in the Manual of Vertebrates (above cited), but it has not yet been fully characterized. I give below a comparison of the typical species of *Eucalia* with that of *Apeltes*, the genus most nearly related.

Common characters: Sides not mailed; caudal keel undeveloped; spines not serrated; dorsal spines in small number (3 to 6), ♀ in spring, with colors intensified.

APELTES, Dekay, 1842.**EUCALIA**, Jordan, 1876.(Type, *Gasterosteus quadracus*, Mit.) (Type, *Gasterosteus inconstans*, Kirt.)*Generic characters.*

- | | |
|---|--|
| 1. Dorsal spines not in a right line, the first being on one side of the median line when erected, the next two on the other. | 1. Dorsal spines in a right line. |
| 2. Ventral plates two, one on each side of the ventral fins. | 2. Ventral plates coalesced into a narrow plate on the median line between the ventral fins. |
| 3. No distinct post-pectoral plate. | 3. A distinct sub-quadrate post-pectoral plate. |

Associated characters.

- | | |
|---|---|
| 4. Dorsal spines normally III-I. | 4. Dorsal spines normally IV-I. |
| 5. Dorsal spines high, diminishing in size backwards. | 5. Dorsal spines lower, diminishing in height forwards. |
| 6. Suborbital plate, silvery, very distinct, semicircular. | 6. Suborbital plate, indistinct, lunate. |
| 7. A developed bony ridge on each side of the dorsal spines. | 7. Dorsal ridge rudimentary and on median line. |
| 8. Caudal peduncle very long and slender—as long as head; its least depth 4 to 5 times in its length. | 8. Caudal peduncle short and relatively stout—shorter than head; its least depth about $\frac{1}{3}$ of its length. |
| 9. Species in salt or brackish waters. | 9. Species in inland brooks and lakes. |
13. *Eucalia inconstans* (Kirt.), Jor.

Depth equal to length of head, four times in body to base of caudal. Curve of the back rising very slowly. Eyes rather large, longer than snout, $3\frac{1}{2}$ in head, much wider than interorbital space. Curve of back descending rather abruptly towards the tail along the base of the soft dorsal. Curve of belly moderately convex,

ascending to form a slight constriction on caudal peduncle. Caudal peduncle rather thick, slenderest in females. Vent much nearer tip of caudal than snout (in Ohio specimens this is not true). Body compressed, but much less so than in either *pygmæa* or *cayuga*. Fin rays, D. IV.-I., 10 varying to III.-1, 9, and V.-I., 10. A. I, 10, V. I, 1. P. 10 to 12. C. 14.

Dorsal spines low and distant, not half so high proportionally as in *cayuga*; soft dorsal low, the first ray about twice as long as the spines. Anal similar, rather smaller, about three times the height of the curved spine which precedes it. Ventrals short and weak, shorter than eye (Wisconsin specimens), or rather longer (Ohio specimens).

Colors in life (in May), males jet black, somewhat coppery about the mouth; females olivaceous and mottled, finely dotted with black; young like the females. Length 2 to 2½ inches.

Habitat. Little sluggish brooks, among weeds and grass, from Ohio to Minnesota (?Greenland, Cope). Usually in company with *Umbra limi*. The species is notable for its pugnacity and voracity, and for its nest-building habits.

I have specimens from Oconto, Outagamie, Calumet, Winnebago, Brown, Racine, Sauk, Dane, Walworth, Green, and Jefferson Counties, in Wisconsin and from Cuyahoga County, Ohio.

14. *Eucalia inconstans* subsp. *cayuga*, Jordan, Man., Vert., 1876, p. 249.

Depth much less than length of head, $4\frac{1}{2}$ in length of body; head $3\frac{1}{2}$. Back arched considerably. Eyes large, as long as snout, wider than interorbital space, $3\frac{1}{4}$ in head. Caudal peduncle relatively much longer and more slender than in *inconstans*, its length about equal to depth of body.

Vent much nearer snout than base of caudal, as near as middle of caudal. Head, ventral cuirass, etc., about as in *inconstans*, body more strongly compressed.

Fin rays D. IV.-I., 10; A. I., 10.

Ventral spine stout, long, equal to depth of head at eyes, or to length of head behind eyes. Last dorsal spine $\frac{2}{3}$ height of first soft ray; fins all high. Anal spine $\frac{3}{4}$ height of first ray.

Color olivaceous, reticulated and mottled with darker. Length $1\frac{1}{2}$ to 2 inches.

Habitat. Cayuga Lake, N. Y.; many specimens dredged by Dr. B. G. Wilder.

The special characters of this variety seem to be its small size,

high fins, and long caudal peduncle. If these prove constant, it may be necessary to consider it a species.

Sauvage (Nouvelles Archives du Museum, 1873) has distinguished a genus, *Gasterosteus*, based on *G. pungitius*, Linnæus, which seems to be equivalent to *Pygosteus*, Brevoort.

15. *Zygonectes dispar*, Agassiz.

Zygonectes dispar, Agassiz, Am. Journ. Sc. Arts, 1854 (Illinois River).

Nelson, Bull. Ills. Mus. Nat. Hist. 1876, 42 (Illinois River).

Body short and deep, much compressed. The depth $4\frac{1}{3}$ in length. Head short and very broad, the flat interorbital space being $\frac{3}{4}$ of its length, and nearly twice the distance between the eyes below. The eyes, therefore, are oblique, sloping downwards and inwards, therefore better seen on a view from below than from above. Head $3\frac{3}{4}$ in length; eye nearly 3 in head.

Snout broadly rounded in front. Upper cheeks and top of head with large scales. Lower parts with small ones, appearing naked.

Fin rays D. about 7; A. 9 or 10. Fins all small except caudal and perhaps anal. Dorsal much behind anal and not half as large, its front midway between front of eye and tip of caudal. Pectorals narrow; caudal large and rounded. The fins are very fragile, so that it is almost impossible to count the rays.

Scales large, in 33 to 36 transverse rows, about 10 longitudinal ones, the scales strongly marked with concentric ridges.

Branchiostegals apparently 3. Vent a little nearer snout than base of caudal. Ventrals small and short.

Color pale olive in spirits, bluish in life; a brownish line along the edges of each row of scales, appearing wavy or serrated as it follows the scales. About 10 of these lines, which are very distinct, a little wider forwards, narrower than the interspaces.

Males (?), with these lines interrupted and further marked with about 9 crossbars, not one-third as wide as the interspaces, obscure forwards, most distinct over anal.

Length of all adult specimens seen, just $1\frac{1}{2}$ inches.

Habitat. Rivers and lakes of N. Ind. and Illinois. Abundant wherever noticed. They swim about near the surface, slowly, as if it were very hard work.

This species bears little resemblance to *Z. notatus*, the type of *Zygonectes*. This latter species is Rafinesque's "*Semotilus? notatus*." I have accordingly substituted the name of *notatus* for *olivaceus*, Storer. I have also substituted *Fundulus diaphanus*

for *F. multifasciatus*. Le Sueur's type of his *Hydrargira diaphana* and *multifasciata* both came from Saratoga Lake, and his descriptions apparently refer to the same species. *Diaphanus*, Le Sueur, is the name first used. *Fundulus diaphanus* is the most widely diffused of all our Cyprinodonts, occurring in brackish water as well as in ponds and springs, from Massachusetts to Colorado.

Zygonectes is not well distinguished from *Haplochilus*, McClelland. *Micristius*, Gill, is probably a synonym.

16. *Fundulus menona*, Jor. and Copeland, sp. nov.

Among the fishes sent to us by Dr. Hoy is a species of *Fundulus*, which seems to be new to science. It is characterized as follows:—

Body elongate, slightly compressed, not elevated, its depth 5 in length. Head long and large, $3\frac{2}{3}$ in length, flat on top, and rather narrow, the breadth of interorbital space half greater than width of eye. Eye 4 in head.

Mouth moderate, of the usual form. Length of head $1\frac{3}{4}$ in distance to dorsal.

Fin rays D. 12; A. 10; V. 6; B. 5.

Dorsal in advance of anal moderately long, and not very high. Anal short and very deep, the longest ray $\frac{2}{3}$ the length of the head. Pectorals short, reaching ventrals; ventrals short, scarcely reaching anal. Vent midway between front of eye and base of caudal.

Scales moderate, in 48 transverse rows, and about 12 longitudinal ones, not small, but very closely imbricated.

Color in spirits dark olive brown, with numerous narrow vertical silvery bands, or dark olive above, this color extending down the sides and around the belly, forming 16 bands, which are separated by shining, silvery interspaces, which are narrower than the bands, and very distinct. The dark spaces are broadest behind. Cheeks and opercle silvery. Traces of dark lines along the rows of scales. Fins unspotted.

Length $3\frac{1}{4}$ inches.

Habitat. Catfish River, Dane Co., Wisconsin (outlet of Lake Menona near Madison).

This species is most nearly related to *Fundulus diaphanus* (*multifasciatus*). The latter, however, differs entirely in coloration, being silvery olive, with narrow black bars, and the dorsal region irregularly spotted. *F. menona* further has the head longer and

narrower, the scales rather larger and more closely imbricated. The vent in *F. diaphanus* is about midway between the middle of caudal and the front of eye. *F. menona* perhaps reaches a larger size than the other species.

17. *Dorosoma cepedianum* (Le S.), Gill.

This species is now abundant in Lake Erie and Lake Michigan, as well as in the larger tributaries of the Mississippi River. It has come into the great lakes through the canals. As a help to the settlement of the question of the relation of the western fish (*Dorosoma notatum*, Raf., *Chatoëssus ellipticus*, Kirt.) and the eastern one, I give here a detailed account of the specimen in the Indiana collection from the Wabash River, at Merom.

Body deep, much compressed, but not greatly elevated. Mouth small, inferior, snout rounded. Depth $2\frac{1}{2}$ in length, without caudal. Head 4. Eye twice length of snout, $4\frac{1}{2}$ in head. Length of top of head $3\frac{1}{4}$ in distance to origin of dorsal.

Fin rays D. II., 11; A. II., 30; V. 8.

Scales in about 56 transverse rows and 20 longitudinal ones. 17 scutes in front of ventral fins, 12 behind.

Dorsal fin beginning midway between snout and middle of base of caudal, the last or filamentous ray being equal to the length of the head, nearly twice the length of the longest ray not filamentous, and more than twice the base of the fin. Pectorals scarcely reaching ventrals, $1\frac{1}{4}$ in head. Ventrals reaching half way to anal, $2\frac{1}{6}$ in head. Vent about midway between snout and tip of caudal. Anal base a little longer than head, three times its longest ray. Caudal fin widely forked, largely scaly at base. Depth of caudal peduncle half length of head.

In spirits, nearly uniformly silvery.

Length of specimen $10\frac{1}{2}$ inches.

18. *Esox salmoneus*, Raf.

I have adopted Rafinesque's name for the common Little Pickerel of the Western States, because it is undoubtedly the species which Rafinesque had in mind, notwithstanding his statement that "it reaches the length of five feet." *Esox umbrosus*, Kirtland, is the same fish, as I know from the examination of his original type. Some of Le Sueur's unidentified species probably belong here.

Esox cypho, Cope, of which I have examined specimens from

Fox River, Illinois, is quite distinct. It is locally known as the Buffalo Pike.

Rafinesque's name, *Picorellus*, may be used for the species of *Esox*, with the cheeks and opercles entirely scaled. It is equivalent to the group "Pickerels" of Girard. This character is, however, hardly of generic value.

19. *Minnilus ariommus*, Cope.

This species is locally quite abundant in White River, about Indianapolis, in which stream Cope's original type was taken. I have, however, not found it in any other river, nor in any of the tributary creeks. It is a rather large and striking species. In size of eye it surpasses all of our other *Cyprinidæ*.

20. *Lythrurus cyanocephalus*, Copeland, MS., sp. nov.

"Hoy's Red Fish." Hoy in Reports on Fishes of Wisconsin.

Lythrurus cyanocephalus, Copeland, MS., Nelson, Bull. Ills. Mus. Nat. Hist., 1876. (Name only.)

Among the unfinished papers of the late Prof. Copeland, are fragments of a synopsis of the Fishes of Wisconsin. In this MS. "Hoy's Red Fish" is described under the above name, from specimens sent by Dr. Hoy, and from others examined from Bass Creek, near Hanover, Wis. The following is Prof. Copeland's description, with a few additional characters taken from the type specimens which are now in my possession.

Body short, stout, deep, chubby, moderately compressed, the depth about 4 in length; dorsal outline elevated, the axis of the body being about half nearer the ventral outline than the dorsal, so that the form is quite unlike that of *L. diploëmius*. Caudal peduncle rather short, not specially contracted.

Head very short, deep, $4\frac{1}{8}$ to $4\frac{1}{6}$ in length, its greatest depth $1\frac{1}{3}$ in its length, equal to the distance from front of eye to edge of opercle. Snout blunt, shorter than eye. Mouth large, very oblique; more so than in any of the others, its angle fully 45° . Lower jaw longest. Maxillary reaching to opposite anterior border of eye. A slight occipital depression. Interorbital space wide, wider than eye. Eyes large, $3\frac{1}{3}$ in head.

Fin rays D. I. 8; A. I. 11 in one, I. 12 in others.

Fins large. Dorsal well behind ventrals, with a large black spot which involves the bases of the anterior rays, the whole spot about equal to the eye in extent. Longest dorsal ray about equal to head. Pectorals rather short and broad, not reaching ventrals.

Ventrals shortish, reaching anal. Anal long and high, its free border concave. Dorsal considerably nearer caudal than snout. Ventrals a little nearer snout than caudal.

Lateral line with 46 scales, 9 rows above and 4 below it. Scales small, much crowded anteriorly. Lateral line strongly decurved, forming a broad and regular arc from opercle to opposite end of dorsal, thence nearly straight to the tail. Dorsal scales small. Region anterior to ventrals mostly naked.

Whole top of head, lower jaw, lower part of cheeks, subopercle, muzzle, whole region anterior to dorsal fin and down the sides nearly to the pectorals, studded with small whitish tubercles in the type specimens, which are spring males.

These prominences are smaller and more crowded than in *diplæmius*. In addition, minute asperities occur on the scales of the sides and about the ventral fins.

Color in spirits dark bluish above, pale below, not silvery. In life, males with the sides and fins clear bright red, back and especially the top of the head, a bright glaucous blue. Females probably pale olivaceous.

Length $2\frac{1}{2}$ inches. Teeth 2, 4-4, 2, as in *L. diplæmius*.

Habitat. Root R., Racine Co., Wis. (Hoy). Tributary of Rock R. (Copeland).

This species has been long known to Dr. Hoy and Dr. Kirtland, but it has hitherto escaped description. Specimens were long ago sent to Girard for description, but in some way they were lost. *L. cyanocephalus* resembles *L. diplæmius*, but it is smaller and more compact, with smaller fins. Dr. Kirtland's *Leuciscus diplemius* is the male of *Luxilus cornutus* var. *gibbus*, Cope. His *Leuciscus compressus* is probably, in part at least, the female of *Lythrurus diplæmius*.

21. *Chrosomus erythrogaster*, Rafinesque.

In an unfinished MS. "Review of the genus *Chrosomus*," Prof. Copeland shows that the current species of this genus, viz., *C. erythrogaster*, Raf. (= *C. oreas*, Cope), *C. pyrrhogaster*, Jordan (= *C. erythrogaster*, Ag.), and *C. eos*, Cope., are probably forms or varieties of one species, the alleged distinctions proving quite illusive.

Highly colored males of *C. erythrogaster* from Wisconsin have the fins bright yellow, and the scales of nearly the whole body

provided with very minute tubercles, similar to those on the head of *Minnilus rubifrons*.

22. *Moxostoma anisurum* (Raf.).

Catostomus anisurus of Kirtland, and undoubtedly that of Rafinesque also, is the fish lately called *Ptychostomus collapsus* by Prof. Cope. *P. velatus*, Cope, seems to be the young of the same species.

23. *Placopharynx carinatus*, Cope.

Proc. Am. Philos. Soc. 1870.

Through the kindness of Dr. Levette, I have received a set of the pharyngeal bones of this species. A member of the Geological Survey informs me that they are found in a large, coarse species of sucker, which is common in the spring at Terre Haute and elsewhere on the Wabash. The genus and species were originally based on a single specimen, but there can be no doubt as to their validity. Since the above was written, I have seen another set of these bones from the Falls of the Ohio, and also a skull and part of the skeleton of this species, found in the Scioto R. at Columbus, Ohio, by Dr. J. M. Wheaton.

24. *Carpiodes difformis*, Cope.

Proc. Am. Philos. Soc. 1870.

The *Ichthyobus difformis* of Nelson (Bull. Ills. Mus. p. 49) is *Carpiodes cutisanserinus*, Cope. The two species are undoubtedly distinct, although I once held the contrary opinion.

25. *Carpiodes carpio*, Rafinesque.

Carpiodes nummifer, Cope. Proc. Am. Philos. Soc. 1870.

Although Rafinesque's *Catostomus* (*Carpiodes*) *carpio* is said to have 36 dorsal rays, yet his description so evidently refers to this common species, that I have adopted his specific name. I do not now think it necessary to unite *Ichthyobus* with *Carpiodes*.

26. *Ichthyobus bubalus*, Rafinesque.

This species, which reaches quite a large size, differs from its congeners in having the dorsal region but very little elevated, so that the axis of the body is very nearly midway between the dorsal and ventrals.

A specimen from the Wabash R., 27 inches long, and weighing 15 lbs., showed the following characters:—

Head = depth, $3\frac{1}{2}$ in length; eye, small, $6\frac{1}{2}$ in head; depth of head, $\frac{5}{8}$ its length; opercle, very wide, convex, and furrowed;

scales, very large; color, dull brownish-olive, not silvery. D. II. 27; A. I, 9; lateral line, 40.

27. *Ichthyobus cyanellus*, Nelson.

Bull. Ills. Mus. Nat. Hist. 1876, 49.

This species is undoubtedly distinct from all previously described, unless it be *I. rauchii*, Ag. Specimens from St. Louis, which I have identified as probably *I. rauchii*, differ from Nelson's types in several particulars, notably in the midway position of the dorsal. What Agassiz's *I. rauchii* and *I. stolleyi* really are, no one can tell from the descriptions.

I. cyanellus differs from *I. bubalus* in having a much deeper body, larger and higher dorsal, and smaller mouth.

28. *Ichthyobus ischyurus*, Nelson, sp. nov.

In the Illinois State Collection, Mr. Nelson has found still another species of this type, remarkable for the stout and deep body. The following description has been forwarded by him for publication:—

“This is a very stout and heavily built species. Depth, $2\frac{1}{2}$ in length; head, extremely broad between the eyes and but slightly convex; its length $3\frac{1}{2}$ times in length of body; snout, short and rounded, opercular apparatus large; depth of head, $1\frac{1}{2}$ in its length; width of head, $1\frac{1}{2}$; eye, $6\frac{2}{3}$ in head, $1\frac{2}{3}$ in snout, 4 in interorbital space; caudal peduncle a little deeper than long.

“Scales, 7–37–7, nearly uniform, a little crowded anteriorly, finely punctate. Fins, all small. Dorsal, I. 27; A. I. 8; bluish-olive above, yellowish below; fins blackish.”

Type specimens $11\frac{1}{2}$ inches long, from Mackinaw Creek in Central Illinois, a tributary of Illinois R. Several younger specimens also in the State Collection.

29. *Bubalichthys altus*, Nelson, sp. nov.

“This specimen is very deep and much compressed. The back is much arched and the profile descends steeply in front to end of snout, not forming an angle with it as in many species of *Ichthyobus*.

“Depth of body, $2\frac{1}{2}$ in length; head, 4 in length; greatest thickness of body, $1\frac{2}{3}$ in length of head; depth of head, $1\frac{1}{2}$ in its length; width, $1\frac{1}{2}$ in length. Eye, $5\frac{1}{2}$ in head, $2\frac{1}{2}$ in interorbital space, which is but little rounded.

"Lateral line perfectly straight from upper edge of opercle to caudal.

"Scales, 8-35-5. Dorsal I. 25; A. I. 9.

"Color in spirits, dull yellowish-olive; fins dusky.

"Type specimen 12 inches long, in Ills. State Museum, from Cairo, Illinois."

The type specimen I have examined. It is certainly distinct from *B. bubalus*, Ag., and still more so from *B. niger*. *B. vitulus*, Ag., as far as one can tell, judging from the very superficial description, is also different. The most striking characters of *B. altus*, are the great depth and compression of the body.

30. *Bubalichthys bubalus*, Agassiz.

? *Catostomus bubalus*, Kirtland, Bost. Journ. Nat. Hist. (not of Rafinesque).

Bubalichthys bubalus, Agassiz, Am. Journ. Sc. Arts, 1855.

Four specimens of this species from the Mississippi River at Quincy, Illinois, show the following characters:—

Body considerably elevated and compressed above; the dorsal region sub-carinate; belly thicker. Depth $2\frac{3}{4}$ in length. Axis of the body above the ventrals, below the lateral line and nearly twice as far from the back as the belly. Greatest depth of body at beginning of dorsal, which is in advance of ventrals, and a trifle nearer the snout than the caudal.

Head wide, rounded across the top, wider above eyes than across cheeks. Interorbital space 2 in head. Head 4 in length of body, its greatest depth $1\frac{1}{8}$ in its length. Eye = snout 4 in head, much larger than in *B. niger*.

Mouth small, notably smaller than in *B. niger*, and with thinner lips, which are granulated and feebly plicate. Mandible about equal to eye. Humeral and suborbital bones slightly different from those of *B. niger*, quite unlike those of "*I. rauchii*."

Pharyngeal bones very strong, with large teeth, which grow larger downward. Intestinal canal long, longer than body.

A decided occipital depression. Head triangular in outline, viewed from the side. Ante-orbital region strongly elevated and curved; length of top of head $2\frac{3}{4}$ in distance from snout to occiput. Nostrils large.

Scales 8-40-6 in two specimens, 8-39-6 in one, 7-39-5 in the fourth.

Fin rays, D. I. 28 in two, I. 29 in rest. A. I. 10, V. i. 10.

Dorsal elevated in front and rapidly declined, the seventh ray half the length of the third or longest. The latter reaches to the base of the 18th ray, or more than half the base of the fin. Anal reaching caudal, its rays rapidly shortened. Pectorals shorter than anal, anal than ventrals, all than head.

Length of specimens, three, $12\frac{1}{2}$ inches, the fourth 12 inches. The species probably does not reach a large size.

It is probably best to retain the name *bubalus* for this fish, although it is perhaps doubtful whether it is really Agassiz's species, still more doubtful whether it is Kirtland's *C. bubalus*, and finally it is certainly not Rafinesque's *C. bubalus*, which is an *Ichthyobus*.

31. *Bubalichthys niger* (Rafinesque), Agassiz.

?? *Catostomus* (*Ichthyobus*) *niger*, Raf. Ich. Oh., 1820, 56.

Bubalichthys niger, Am. Journ. Sc. Arts, 1855.

My specimens undoubtedly belong to Agassiz's *B. niger*, but Rafinesque's "entirely black, lateral line straight," are hardly sufficient to characterize his species.

Body much less elevated and less compressed than in *B. bubalus*, the back not at all carinated. Axis of body over the ventrals about at the lateral line, and but an eighth or tenth further from the dorsal line than the ventral. Greatest depth midway of body over ventrals and just in advance of dorsal. Depth $3\frac{1}{8}$ in length.

Head strongly transversely convex, almost ridged above, in length, less narrowed downwards than in *bubalus*. Greatest depth of head $1\frac{1}{8}$ in its length. Interorbital space $2\frac{1}{8}$. Eye = snout $5\frac{1}{2}$ in head, much smaller than in *bubalus*. Snout scarcely projecting. No depression at occiput. An almost even curve from snout to dorsal. Head bounded by curves, therefore not triangular, thicker, larger, and less pointed than in *bubalus*.

Mouth large, with a large and pappillose lower lip. Mandible longer than eye.

Scales 8-41-7.

Fin rays D. I. 30, A. I. 11.

Dorsal not so high nor so rapidly depressed as in *bubalus*, the longest ray scarcely half the length of the base of the fin, reaching to the 15th, the 9th ray, half the height of the first. Anal reaching caudal, its middle rays more rounded, not so much shorter than the first. Pectorals as long as ventrals, both longer than anal and less than head.

Color as in other species of *Ichthyobus* and *Bubalichthys*, but darker. Fins all black.

Length of specimen, from which above measurements are taken, 14 inches.

Habitat. Quincy, Illinois.

SUPPLEMENT.

Revision of Genera and other Ichthyological matters.

XENOTIS, Jordan, gen. nov.

I have for some time noticed a striking difference in the character of the appendages to the anterior branchial arches in the different genera of sunfishes. In *Pomotis*, and part of the species of *Lepomis*, these appendages are soft, short, and blunt, similar to those on the other gill arches. In the other genera, one of the rows on the anterior arch is considerably modified—those on the lower part of the arch, at least, being stiffer, more slender, and very much longer than those in *Pomotis*. This character seems to me a very important one, and one of generic value. In this view I am supported by Prof. Cope.

The original type of *Lepomis*, Raf., was *Labrus auritus* of authors, which, with Prof. Gill, I identify as *Ichthelis rubricauda*, Holbrook, one of the species with long gill appendages. The name *Lepomis* remains, therefore, for those species with the gill rakers long.

For the species of the old genus *Lepomis*, with the gill appendages short, I would propose the name of *Xenotis*. The type of *Xenotis* is *Pomotis fallax*, B. & G. The full generic characters are given above.

The following species have been examined with reference to this character:—

Appendages long (*Lepomis*).

Auritus, Linné (type).
Appendix, Mitchill.
Incisor, Cuv. & Val.
Speciosus, B. & G.
Obscurus, Ag.
Aquilensis, Grd.
Anagallinus, Cope.
Oculatus, Cope.
Nephelus, Cope.

Appendages short, undifferentiated (*Xenotis*).

Fallax, B. & G. (type).
Sanguinolentus, Agassiz.
Megalotis, Raf.
Nitidus, Kirtland.
Inscriptus, Agassiz.
Breviceps, B. & G.
Popii, Grd.

The following are the changes in nomenclature in the *Centrarhynchidæ* which are considered necessary by Prof. Cope and the writer:—

(a) *Pomotis*, Cuvier, for *Pomotis*, Raf. (1819). Rafinesque's name can only be considered as a synonym of his own *Lepomis*. *Pomotis*, if used at all, must stand as characterized by Cuvier, who proposes it as a new genus, and makes no direct allusion to Rafinesque. It does not seem necessary to coin a new name for this group.

(b) *Apomotis*, Raf. 1819, for *Telipomis*, Raf. 1820 (Nelson emend.). *Apomotis* was based on two species, *cyanellus* and *macrochirus*, the first of which seems to belong to this genus as emended by us. In the *Ichthyologia Ohiensis*, the name *Apomotis* was without reason changed to *Telipomis*. The species referred by Cuvier to *Bryttus* probably belong to *Apomotis*, but, as no American author has recognized any of them, that point must at present remain undecided.

(c) *Calliurus*, Raf. 1819, for "*Micropterus*, Lacépède, 1800" (Gill emend.) = *Grystes*, *Huro*, *Dioplites*, etc., auct. Lacépède's original description of his *Micropterus dolomieu* is absurd, but his figure bears some resemblance to the black bass. Notwithstanding the fact that Cuvier asserts that Lacépède's original specimen, then still preserved in the museum, was identical with *Labrus salmoides*, Lac., since Lacépède found teeth on the tongue, only five branchiostegals and two anal spines, Cuvier's identification was uncertain and insufficient for the preservation of the name. Cuvier himself thought the name unworthy of adoption ("Le genre et l'espèce du microptère doivent disparaître du catalogue des poissons," *Hist. Nat. des Pois.*, vol. v. p. v. Cuv. et Val.). In view of this, Prof. Cope thinks that *Micropterus* (like *Aplocentrus*, *Pogostoma*, and *Proceros*, Raf.) should be rejected as an unidentifiable myth, and the name next in order of priority—*Calliurus*, Raf.—be adopted as the generic name for the black bass.

EPISEMA, Cope and Jordan, gen. nov.

Pharyngeal teeth with the principal series 4-4, of the raptorial type, with acute edges. Alimentary canal short. Dorsal fin standing immediately above the ventrals. Fin radii normal; lips soft, not enlarged; the upper protractile; no barbels. Lateral line complete.

The above characters were formerly applied by Prof. Cope to the genus *Photogenis*, but it appears that the dorsal fin is not immediately above the ventral in *P. spilopterus*, the type, which must on this account be referred to the neighborhood of *Minnilus*.

Four of the seven species referred by Prof. Cope to *Photogenis* present the characters above enumerated, and one of them, the *P. scabriceps*, is regarded as the type of the genus so defined. As the name *Photogenis* was first employed for, and has been specially attached to, the *P. spilopterus*, it cannot be used for the *P. scabriceps* and its allies, so that a new name, *Episema*, is now proposed for the latter.

The following species are at present referred to *Episema* :—

Group I. Colors transparent, without pigment ; scales with usual surface exposed.

Episema leucioda, Cope.

Episema telescopus, Cope.

Episema piptolepis, Cope.

Episema scabriceps, Cope (type).

Group II. Colors pigmented, brilliant ; exposed surfaces of scales more narrow and high.

Episema (?) *pyrrhomelas*, Cope.

Episema callisema, Jordan.

The species last mentioned has the teeth in a single row.

Episema may be compared with related genera as follows :—

Teeth raptatorial, with the principal series 4-4 ; lateral line complete ; fin radii normal ; no barbels ; lips soft, not enlarged.

a. Teeth with masticatory surface developed.

b. Dorsal decidedly posterior to ventrals.

LYTHRURUS.

bb. Dorsal over ventrals.

d. Scales normal.

HYBOPSIS.

dd. Scales closely imbricated, the exposed surfaces high and narrow.

LUXILUS.

aa. Teeth with the edges crenate.

CYPRINELLA.

aaa. Teeth entire without masticatory surface.

e. Dorsal over ventrals.

EPISEMA.

ee. Dorsal behind ventrals.

MINNILUS.

Moniana, Grd., is not generically distinct from *Cyprinella*. *Codoma* and *Cliola* are, perhaps, synonymous with *Minnilus*. *Tigoma* is an "*omnium gatherum*," the precise value of which is not yet determined.

Minnilus xænurus, Jordan, sp. nov.

Form moderately elongated, subfusiform, heavy forwards; the head being decidedly like *Luxilus*. Depth $4\frac{1}{3}$ in length.

Head stout, somewhat elongated, about 4 in length, the snout but slightly overlapping the large, oblique mouth; the maxillary reaching the orbit. Head roundish above in males, with many small, whitish tubercles, not much crowded, and arranged somewhat in rows—one or two rows of these extend backwards to the dorsal; several series of strong tubercles on each side of caudal peduncle; one along each row of scales. These are very striking, and are apparently characteristic of this species.

Scales high, closely imbricated, as in *Luxilus cornutus*, dark edged, being punctate with black. Lateral line with 37 scales (36 to 39).

Color dark-steel blue; silvery below; a faint black spot at base of caudal. Fins mostly bright crimson red in males, the dorsal largely black on its upper posterior part. Dorsal, anal, and caudal tipped with white pigment; belly, base of anal, ventral and pectoral fins with white pigment.

Eye large, $3\frac{3}{4}$ in head.

Dorsal low, $5\frac{1}{2}$ in length of body. Caudal fin large. Fin rays: dorsal 1.8; anal 1.11 (1.10). Length 3 to $3\frac{1}{4}$ inches.

Teeth 1, 4-4, 1, hooked, entire, without masticatory surface.

Hab. South Fork of the Ocmulgee River, at Flat Shoals, De Kalb Co., Georgia.

This species is one of the most beautiful of the *Cyprinidæ*. The long anal fin and the presence of rows of tubercles on the caudal peduncle are striking characters. The latter feature suggests the specific name (*xaino*, to scratch). It resembles *Episema pyrrhomelas*, Cope, but is distinguished at once by the generic character of the backward dorsal.

This species belongs to the subgenus of *Minnilus*, which has been called *Photogenis*. The following are the species of *Minnilus* as at present understood—several species now referred to other genera probably also belong here:—

Subgenus MINNILUS: colors transparent; little or no pigment; scales normal.

Minnilus arge, Cope.

Minnilus dinemus, Raf. (type of genus).

Minnilus jemezianus, Cope.

Minnilus lepidulus (Grd.), C. & J.
Minnilus micropteryx, Cope.
Minnilus matutinus, Cope.
Minnilus rubellus (Ag.), C. & J.
Minnilus dilectus (Grd.), C. & J.
Minnilus amœnus (Abbott), C. & J.
Minnilus megalops (Grd.), C. & J.
Minnilus amabilis (Grd.), Nelson.
Minnilus socius (Grd.), C. & J.
Minnilus stilbuis, Jordan.
Minnilus umbratilis (Grd.), C. & J.
Minnilus percobromus, Cope.
Minnilus rubrifrons, Cope.
Minnilus altipinnis, Cope.
Minnilus oligaspiis, Cope.
Minnilus simus, Cope.
Minnilus ariommus, Cope.
Minnilus photogenis, Cope.

Subgenus **PHOTOGENIS**: colors brilliant, pigmentary; scales imbricated, so that the exposed surfaces are high and narrow.

Minnilus spilopterus, Cope.
Minnilus analostanus (Grd.), C. & J.
Minnilus eurystomus, Jordan.
Minnilus callistius, Jordan.
Minnilus stigmaturus, Jordan.
Minnilus cœruleus, Jordan.
Minnilus xænurus, Jordan.
Minnilus lirus, Jordan.

The last species has the teeth 2, 4-4, 2, as in *Lythrurus*; the other colored species 1, 4-4, 1.

Certain species of *Ceratichthys*, Baird, were separated from that genus under the name of *Nocomis*, Girard, before *Ceratichthys* itself had ever been characterized. It seems necessary therefore to substitute *Nocomis* for *Ceratichthys*.

***Moxostoma anisurum*, Raf.**

Catostomus (Moxostoma) anisurus, Raf. Ich. Oh. (not of Ag.).

Catostomus anisurus, Kirt. Bost. Journ. Nat. Hist.

Prof. Cope, after examination of one of my specimens of this species, dissents from my identification of *Ptychostomus collapsus*, Cope, with it, considering the *anisurum* a related species, previously unknown to him. I therefore give its full characters, leaving the matter for further investigation.

Body compressed, short and stout, the back strongly elevated. Depth $3\frac{2}{3}$ in length, without caudal.

Head $4\frac{1}{3}$ in body, short and thick, with vertical cheeks and a broad, flat, and steep interorbital space. Interorbital space equal to snout, $2\frac{1}{3}$ in head. Eye midway of head, 4 in length of head. A prominent depression across nose.

Mouth very small, the lower lip small, infolded, and A-shaped behind.

Pectorals small, reaching two-thirds the distance to the ventrals. Dorsal large; its height $\frac{5}{8}$ length of head; its last ray half-way between snout and base of caudal. Eyes large and high up.

Scales 5-44-4.

Fin rays: D. 1.15; A. 1.8; V. 9.

Color pale olivaceous; sides silvery; dorsal and caudal dark; lower fins orange.

Specimen described 12 inches long, from Lake Erie, at Toledo, Ohio.

Genera of Catostomidæ.

The genera of *Catostomidæ*, accepted by Prof. Cope and the writer, may be thus compared:—

- * Body oblong or elongate, with a short, subquadrate dorsal fin of 10 to 17 developed rays (*Catostomina*, Gill).
 - † Air-bladder in three parts; lateral line present; fontanelle present; scales large, subequal.
 - a. Pharyngeal bones very broad and strong; the lower 7 to 10 teeth on each side, greatly enlarged, smooth, and truncate above; the teeth on the upper part of the bone small, as usual in the family.

PLACOPHARYNX, 1.
 - aa. Pharyngeal bones not specially enlarged; the teeth of the usual type.

MOXOSTOMA, 2.
 - †† Air-bladder in two parts.
 - b. No lateral line; fontanelle present.

ERIMYZON, 3.
 - bb. Lateral line well developed.
 - c. Fontanelle distinct.

CATOSTOMUS, 4.
 - cc. Fontanelle obliterated by the union of the parietal bones.

PANTOSTEUS, 5.
- ** Body much elongated, subcylindrical forwards; dorsal elongate, falciform, of 30 or more rays; fontanelle obliterated by the union of the parietal bones (*Cycleptina*, Gill).
 - d. Mouth small, subinferior, with papillose lips.

CYCLEPTUS, 6.

*** Body oblong oval, compressed; dorsal elongate, elevated in front, of 20 or more rays; fontanelle present (*Bubalichthyina*, Gill).

e. Pharyngeal bones narrow, with the teeth relatively thin and weak.

f. Mouth small, inferior, protractile downwards; fins often greatly elevated. CARPIODES, 7.

ff. Mouth larger, subterminal, protractile forwards (species of larger size, dusky colors, with lower dorsal).

ICHTHYOBUS, 8.

ee. Pharyngeal bones strong; the teeth comparatively coarse and large, increasing in size downwards; dorsal fin moderately elevated; mouth inferior.

BUBALICHTHYS, 9.

Of the above genera, *Carpiodes* and *Ichthyobus* are doubtfully distinct, such species as *C. carpio* connecting them closely.

Moxostoma, Rafinesque, 1820 (Jordan emend. 1876) is equivalent to *Ptychostomus*, Agassiz, 1854 = *Teretulus*, Cope, 1868. *Moxostoma*, Raf., is based on two species: *Catostomus anisurus* and *C. anisopterus*. The latter, described "from a drawing by Mr. Audubon," is unrecognizable or mythical; the former is a common species of "Red Horse," although Agassiz strangely misconstrued both Rafinesque's and Kirtland's descriptions of it. For *C. anisurus* and its numerous congeners, the name *Moxostoma*, having clear priority, must obviously be retained.